

## PATENT ABSTRACTS OF JAPAN

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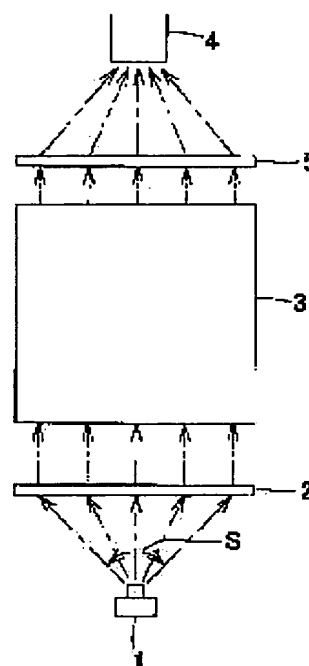
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## (54) ILLUMINATION APPARATUS FOR INSPECTION

## (57)Abstract:

PROBLEM TO BE SOLVED: To provide an illumination apparatus for inspection capable of achieving compactness while maintaining advantage in terms of cost.

SOLUTION: The illumination apparatus for inspection is provided with an illumination means 1 with a predetermined angle of illumination, a first lens 2 for condensing and converting light from the illumination means 1 into parallel light, and a second lens 5 for condensing light after the parallel light from the first lens 2 has passed through a through hole formed in an object to be inspected 3 and capturing the light in an image pickup means 4.



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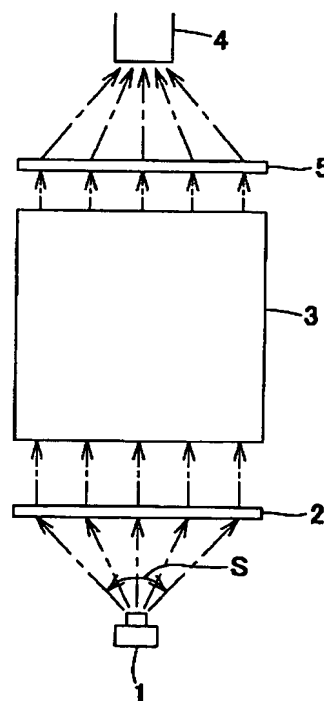
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(54) 【発明の名称】 検査用照明装置

(57) 【要約】

【課題】 コスト面において有利にしながらも、小型化を図ることができる検査用照明装置を提供する点にある。

【解決手段】 所定の照射角を有する照明手段1と、前記照明手段1からの光を集光させて平行光に変換する第1レンズ2と、前記第1レンズ2からの平行光が検査対象物3に形成の貫通孔を通過した後の光を集光させて撮像手段4に取り込み可能とするための第2レンズ5とを備えている。



## 【特許請求の範囲】

【請求項1】 所定の照射角を有する照明手段と、前記照明手段からの光を集光させて平行光に変換する第1レンズと、前記第1レンズからの平行光が検査対象物に形成の貫通孔を通過した後の光を集光させて撮像手段に取り込み可能とするための第2レンズとを備えてなる検査用照明装置。

【請求項2】 所定の照射角を有する照明手段と、前記照明手段からの光の光軸をほぼ直交する方向に変更するための第1全反射ミラーと、この第1全反射ミラーからの反射光の光軸をほぼ直交する方向に変更することにより、該反射光を前記照明手段からの照射方向とは反対方向に変更するための第2反射ミラーと、前記第2全反射ミラーからの反射光を集光させて平行光に変換する第1レンズと、前記第1レンズからの平行光が検査対象物に形成の貫通孔を通過した後の光を集光させる第2レンズと、前記第2レンズからの光の光軸をほぼ直交する方向に変更するための第3全反射ミラーと、この第3全反射ミラーからの反射光の光軸をほぼ直交する方向に変更することにより、該反射光を前記照明手段からの照射方向と同一方向に向けて撮像手段に取り込み可能とするための第4全反射ミラーとを備えてなる検査用照明装置。

【請求項3】 前記第1レンズ及び第2レンズが、フレネルレンズからなる請求項1又は2記載の検査用照明装置。

【請求項4】 前記検査対象物が、自動車用の触媒である請求項1又は2記載の検査用照明装置。

【請求項5】 前記照明手段の光軸と前記撮像手段の撮像中心とがほぼ同一位置になるように該照明手段及び該撮像手段とを同一側に配置してなる請求項2記載の検査用照明装置。

【請求項6】 前記第2レンズを検査対象物の載置台上構成してなる請求項2記載の検査用照明装置。

## 【発明の詳細な説明】

## 【0001】

【発明の属する技術分野】 本発明は、特に、貫通孔を備えた自動車用の触媒の孔詰まり検査を行う場合に好適であり、又、貫通孔を備えた基板の孔の状態検査や貫通孔を備えた円筒部材の内面の検査等においても用いることができる検査用照明装置に関する。

## 【0002】

【従来の技術】 上記検査用照明装置として、例えば自動車用の触媒に形成されている多数の孔が詰まっているかどうかの検査を行うための装置を例に挙げて説明すれば、光を触媒にその孔の形成方向から照射する照明手段を設け、その照明手段からの照射光が孔を通過した光を撮像手段に取り込むことができるように絞り込むためのテレセントリックレンズを設けて、撮像手段に取り込んだ光をモニター等に映し出し、孔詰まり箇所があるか否かを判断するようにしている。

## 【0003】

【発明が解決しようとする課題】 前記テレセントリックレンズを使用することによって、厚みの異なる立方形状の検査対象物を測定する場合等において、ビントがずれることがなく、高精度な画像処理を行うことができる利点があるものの、テレセントリックレンズが高価なものであるため、装置全体がコストの高くなる不都合があった。しかも、大きな検査対象物を撮像する場合には、その大きさに合ったテレセントリックレンズを用いなければならぬため、更に前記不都合を顕著にするものであった。又、テレセントリックレンズは、一般的に他のレンズに比べて厚肉であるため、光の照射方向において照明装置が大型化する不都合も発生していた。

【0004】 本発明が前述の状況に鑑み、解決しようとするところは、コスト面において有利にしながらも、小型化を図ることができる検査用照明装置を提供する点にある。

## 【0005】

【課題を解決するための手段】 本発明の検査用照明装置は、前述の課題解決のために、所定の照射角を有する照明手段と、前記照明手段からの光を集光させて平行光に変換する第1レンズと、前記第1レンズからの平行光が検査対象物に形成の貫通孔を通過した後の光を集光させて撮像手段に取り込み可能とするための第2レンズとを備えている。照明手段から所定の照射角を持って照射された光は、第1レンズにて平行光に変換され、検査対象物に照射される。そして、検査対象物の貫通孔を通過した光を第2レンズにて集光させることにより該光を撮像手段に取り込むことができる。撮像手段に取り込まれた光を画像処理してモニター等に映し出すことにより、貫通孔に詰まり等が発生しているか否かを判断することができる。前記照明手段として平行光を照射する構成のもの（例えば面状に発光する面状発光体（バックライトともいう））を用いるものに比べて、コストの低減を図ることができることは勿論のこと、前記のように照射角を持って照射する照明手段とすることによって、照明手段自体の小型化を図ることができる。又、検査対象物の位置が変化するような動きのある検査対象物を撮像するものではないから、従来のようなテレセントリックレンズを使用する意味がなく、通常のレンズで済ませても何等問題にならない。

【0006】 所定の照射角を有する照明手段と、前記照明手段からの光の光軸をほぼ直交する方向に変更するための第1全反射ミラーと、この第1全反射ミラーからの反射光の光軸をほぼ直交する方向に変更することにより、該反射光を前記照明手段からの照射方向とは反対方向に変更するための第2反射ミラーと、前記第2全反射ミラーからの反射光を集光させて平行光に変換する第1レンズと、前記第1レンズからの平行光が検査対象物に形成の貫通孔を通過した後の光を集光させる第2レンズ

と、前記第2レンズからの光の光軸をほぼ直交する方向に変更するための第3全反射ミラーと、この第3全反射ミラーからの反射光の光軸をほぼ直交する方向に変更することにより、該反射光を前記照明手段からの照射方向と同一方向に向けて撮像手段に取り込み可能とするための第4全反射ミラーとを備えさせて、検査用照明装置を構成してもよい。照明手段からの光が、第1全反射ミラー及び第2全反射ミラーを介して照射方向とは反対方向へ変更される。前記のように2つの全反射ミラーを用いることにより、照明手段から照射された光の照射角度が2段階に拡大される。前記第2全反射ミラーからの反射光は、第1レンズにて平行光に変換され、検査対象物に照射される。そして、検査対象物の貫通孔を通過した光は、第2レンズにて集光された後、第3全反射ミラー及び第4全反射ミラーを介して照明手段からの照射方向と同一方向に変更されてから、撮像手段に取り込むことができる。前記のように2つの全反射ミラーを用いることにより、第2レンズからの集光された光を2段階に集光させて前記撮像手段に確実に取り込むことができる。又、前記のように照明手段と撮像手段とを検査対象物の照射方向からずらして配置することによって、照射方向に一直線上に配置した場合に比べて照射方向での照明装置の小型化を図ることができる。

【0007】前記第1レンズ及び第2レンズを、フレネルレンズから構成することによって、照明装置の小型化を更に図ることができる。又、前記フレネルレンズは、加工し易いので容易に四角形にしたり、穴開け加工を施すことができる。

【0008】前記検査対象物が、自動車用の触媒のような多数の小さな孔を有するものである場合には、このような検査用照明装置が有利である。

【0009】前記照明手段の光軸と前記撮像手段の撮像中心とがほぼ同一位置になるように該照明手段及び該撮像手段とを同一側に配置することによって、光の照射方向と直交する方向においても小型化を図ることができる。

【0010】前記第2レンズを検査対象物の載置台に構成することによって、特別な載置台を不要にすることができるだけでなく、撮像手段にできるだけ検査対象物を近づけた状態で撮像することができる。

【0011】

【発明の実施の形態】図1に、本発明の検査用照明装置が示されている。この検査用照明装置は、所定の照射角Sを有する照明手段1と、前記照明手段1からの光を集光させて平行光に変換する第1レンズとしての第1フレネルレンズ2と、前記第1フレネルレンズ2からの平行光が検査対象物としての自動車の触媒3に形成の貫通孔3A(図4参照)を通過した後の光を集光させてCCDカメラ等の撮像手段4に取り込み可能とするための第2レンズとしての第2フレネルレンズ5とを、照明手段か

らの照射光の照射方向に沿って配置している。前記検査用照明装置は、主として自動車用の触媒(セラミック等となっている)3に形成の孔の詰まり等を検査する目的で使用する他、貫通孔を備えた基板の孔の状態検査や貫通孔を備えた円筒部材の内面の状態検査等においても用いることができる。前記撮像手段4にて得られた画像を画像処理してモニター等に映し出す他、場合によっては撮像手段4を省略して第2フレネルレンズ5からの光を直接目視して、触媒3の孔が詰まっているか否かを判断するようにしてもよい。図1では、全ての構成部材が固定されていない宙に浮いた状態を示しているが、実際にはケーシング内に全ての構成部材が収納されることになる。又、前記2つのフレネルレンズ2、5間に配置される触媒3の位置は、第2フレネルレンズ5側に寄った位置、つまり撮像手段4側へ近づけることができる位置がよいが、第1フレネルレンズ2側に寄せてもよい。

【0012】図1に示すように、照明手段1から照射された光は、第1フレネルレンズ2により平行光に変換されてから、触媒3に照射される。そして、触媒3の孔3Aを通過した光が、第2フレネルレンズ5により集光されて撮像手段4に取り込まれるのである。前記照明手段1の照射角Sは、図に示すものに限定されるものではなく、検査対象物の大きさ等に応じて変更することができる。又、前記照射角Sを可変することができる可変式に構成された照明手段1を用いてもよい。

【0013】前記各フレネルレンズ2又は5は、外形が円形又は矩形で、かつ、輪帯状の溝を切って作製されたものを用いることができるが、どのような形状のものであってもよい。又、フレネルレンズが検査用照明装置の小型化を図る上において有利であるが、他のレンズであってもよい。

【0014】前記検査用照明装置を、図2及び図3に示すように構成してもよい。つまり、所定の照射角Sを有する照明手段6と、前記照明手段6からの光の光軸6Aをほぼ直交する方向に変更するための第1全反射ミラー7と、この第1全反射ミラー7からの反射光の光軸6Bをほぼ直交する方向に変更することにより、該反射光を前記照明手段1からの照射方向とは反対方向に変更するための第2反射ミラー8と、前記第2全反射ミラー8からの反射光を集光させて平行光に変換する第1レンズとしての第1フレネルレンズ9と、前記第1フレネルレンズ9からの平行光が検査対象物である自動車用の触媒3に形成の貫通孔3Aを通過した後の光を集光させる第2レンズ及び触媒3の載置台としての第2フレネルレンズ10と、前記第2フレネルレンズ10からの光の光軸6Cをほぼ直交する方向に変更するための第3全反射ミラー11と、この第3全反射ミラー11からの反射光の光軸6Dをほぼ直交する方向に変更することにより、該反射光を前記照明手段6からの照射方向と同一方向に向けてCCDカメラ等からなる撮像手段12に取り込み可能

とするための第4全反射ミラー13とを備えさせて、検査用照明装置を構成している。前記光射出側の2つの全反射ミラー7、8と前記光入射側の2つの全反射ミラー11、13とを同一のもので構成すると共に反射させる光に対して同一取り付け角度に設定することによって、照明手段6と撮像手段12とを同一側に配置することができ、検査用照明装置の水平方向での小型化を図ることができるが、同一側に配置しないで実施することもできる。又、前記照明手段6の光軸6Aと前記撮像手段12への光軸6E、つまり撮像手段12の撮像中心とを一致させることによって、検査用照明装置の水平方向での小型化を更に図ることができるが、一致させないで実施することもできる。図3に示すLは、透明なガラス板又は透明な合成樹脂製の板あるいは透明なシリコンシート等の透明部材であり、前記第2フレネルレンズ10の表面がこれに載置される触媒3により傷付くことを回避できるように前記透明部材を配置して実施することが好ましい。

【0015】従って、照明手段6からの光が2つの全反射ミラー7、8にて照射角度が上げられた後、第1フレネルレンズ9にて平行光に変換される。そして、前記平行光が第2フレネルレンズ10に載置された触媒3の孔3Aに照射され、孔3Aを通過した光及び触媒3の外側を通過した光が第2フレネルレンズ10により集光されて、2つの全反射ミラー11、13にて更に集光され、撮像手段12に取り込まれるのである。ここでは、2つの全反射ミラー7、8にて2段階に照明手段6からの光を上げることによって、照明手段6の小型化を図る上において有利であるが、全反射ミラーを1つのみ設けて実施してもよい。又、第2フレネルレンズ10により集光された光を全反射ミラー11、13にて集光させる他、集光レンズ等を用いて集光させてもよい。

【0016】

【発明の効果】請求項1の発明によれば、所定の照射角を有する照明手段と、前記照明手段からの光を集光させて平行光に変換する第1レンズと、前記第1レンズからの平行光が検査対象物に形成の貫通孔を通過した後の光を集光させて撮像手段に取り込み可能とするための第2レンズとを備えさせるだけで、貫通孔を備えた検査対象物の検査を行うことができ、平行光を照射する構成の照明手段を用いるものに比べて、コストの低減を図ることができることは勿論のこと、照射角を持って照射する照明手段とすることによって、照明手段自体の小型化を図ることができる。又、従来のようなテレセントリックレンズが不要になり、コストの低減を更に図ることができる。

【0017】請求項2の発明によれば、所定の照射角を有する照明手段と、照明手段からの光の光軸をほぼ直交する方向に変更するための第1全反射ミラーと、この第1全反射ミラーからの反射光の光軸をほぼ直交する方向

に変更することにより、反射光を照明手段からの照射方向とは反対方向に変更するための第2反射ミラーと、第2全反射ミラーからの反射光を集光させて平行光に変換する第1レンズと、第1レンズからの平行光が検査対象物に形成の貫通孔を通過した後の光を集光させる第2レンズと、第2レンズからの光の光軸をほぼ直交する方向に変更するための第3全反射ミラーと、この第3全反射ミラーからの反射光の光軸をほぼ直交する方向に変更することにより、反射光を前記照明手段からの照射方向と同一方向に向けて撮像手段に取り込み可能とするための第4全反射ミラーとを備えさせて、検査用照明装置を構成することによって、照明手段の小型化を図ることができるだけでなく、照明手段と撮像手段とを検査対象物の照射方向からずらして配置することにより、照射方向に一直線上に配置した場合に比べて照射方向での照明装置の小型化をも図ることができる。

【0018】請求項3の発明によれば、第1レンズ及び第2レンズを、フレネルレンズから構成することによって、照明装置の小型化を更に図ることができる。又、前記フレネルレンズは、加工し易いので容易に四角形にしたり、穴開け加工を施すことができ、製造面において有利になる。

【0019】請求項5の発明によれば、照明手段の光軸と撮像手段の撮像中心とがほぼ同一位置になるように照明手段及び撮像手段とを同一側に配置することによって、光の照射方向と直交する方向においても検査用照明装置の小型化を図ることができ、設置スペース面において有利になる。

【0020】請求項6の発明によれば、第2レンズを検査対象物の載置台に構成することによって、特別な載置台を不要にすることができるだけでなく、撮像手段にできるだけ検査対象物を近づけた状態で撮像することができ、コスト面及び検査測定面において有利になる。

【図面の簡単な説明】

【図1】第1の検査用照明装置の概略説明図である。

【図2】第2の検査用照明装置の正面図である。

【図3】第2の検査用照明装置の縦断側面図である。

【図4】自動車用の触媒の斜視図である。

【符号の説明】

- 1 照明手段
- 2 第1フレネルレンズ（第1レンズ）
- 3 触媒 3A 孔
- 4 撮像手段
- 5 第2フレネルレンズ（第2レンズ）
- 6 照明手段 6A～6E 光軸
- 7 第1全反射ミラー 8 第2全反射ミラー
- 9 第1フレネルレンズ（第1レンズ）
- 10 第2フレネルレンズ（第2レンズ）
- 11 第3全反射ミラー
- 12 撮像手段

13 第4全反射ミラー

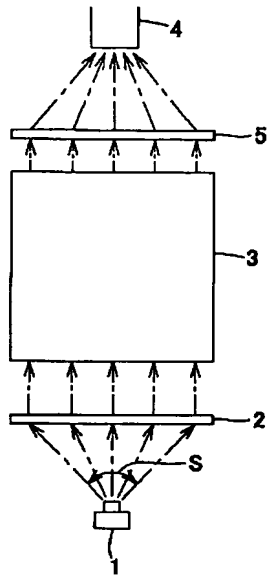
L 透明部材

S 照射角

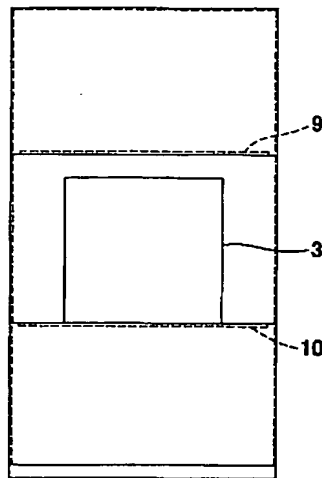
\*

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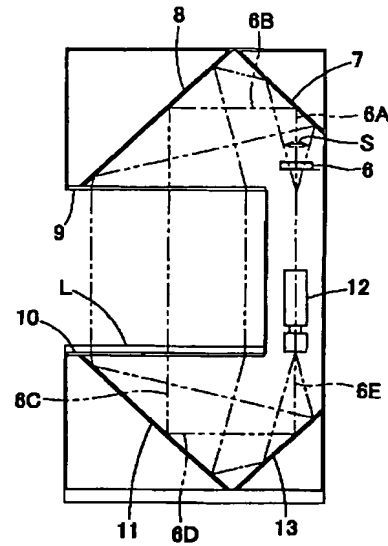
【図1】



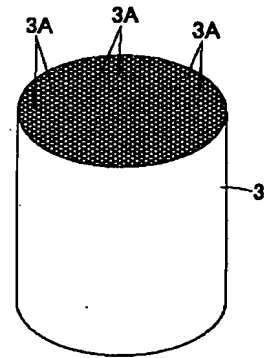
【図2】



【図3】



【図4】



フロントページの続き

(51)Int.Cl.<sup>7</sup>

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識別記号

F I

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GA06

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CLAIMS

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[Claim(s)]

[Claim 1] The checking lighting system which comes to have the 2nd lens for making the light after the parallel light from a lighting means to have a predetermined illuminating angle, the 1st lens which is made to condense the light from said lighting means, and is changed into parallel light, and said 1st lens passes the through tube of formation to an inspection object condense, and making incorporation possible at an image pick-up means.

[Claim 2] By changing a lighting means to have a predetermined illuminating angle, the 1st total reflection mirror for changing the optical axis of the light from said lighting means in the direction which intersects perpendicularly mostly, and the optical axis of the reflected light from this 1st total reflection mirror in the direction which intersects perpendicularly mostly The 2nd reflective mirror for changing this reflected light into an opposite direction with the direction of radiation from said lighting means, The 1st lens which is made to condense the reflected light from said 2nd total reflection mirror, and is changed into parallel light, The 2nd lens which makes the light after the parallel light from said 1st lens passes the through tube of formation to an inspection object condense, By changing the 3rd total reflection mirror for changing the optical axis of the light from said 2nd lens in the direction which intersects perpendicularly mostly, and the optical axis of the reflected light from this 3rd total reflection mirror in the direction which intersects perpendicularly mostly The checking lighting system which comes to have the 4th total reflection mirror for turning this reflected light in the same direction as the direction of radiation from said lighting means, and making incorporation possible at an image pick-up means.

[Claim 3] The checking lighting system according to claim 1 or 2 with which said 1st lens and 2nd lens consist of a Fresnel lens.

[Claim 4] The checking lighting system according to claim 1 or 2 said whose inspection object is a catalyst for automobiles.

[Claim 5]



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CLAIMS

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[Claim(s)]

[Claim 1] The checking lighting system which comes to have the 2nd lens for making the light after the parallel light from a lighting means to have a predetermined illuminating angle, the 1st lens which is made to condense the light from said lighting means, and is changed into parallel light, and said 1st lens passes the through tube of formation to an inspection object condense, and making incorporation possible at an image pick-up means.

[Claim 2] By changing a lighting means to have a predetermined illuminating angle, the 1st total reflection mirror for changing the optical axis of the light from said lighting means in the direction which intersects perpendicularly mostly, and the optical axis of the reflected light from this 1st total reflection mirror in the direction which intersects perpendicularly mostly The 2nd reflective mirror for changing this reflected light into an opposite direction with the direction of radiation from said lighting means, The 1st lens which is made to condense the reflected light from said 2nd total reflection mirror, and is changed into parallel light, The 2nd lens which makes the light after the parallel light from said 1st lens passes the through tube of formation to an inspection object condense, By changing the 3rd total reflection mirror for changing the optical axis of the light from said 2nd lens in the direction which intersects perpendicularly mostly, and the optical axis of the reflected light from this 3rd total reflection mirror in the direction which intersects perpendicularly mostly The checking lighting system which comes to have the 4th total reflection mirror for turning this reflected light in the same direction as the direction of radiation from said lighting means, and making incorporation possible at an image pick-up means.

[Claim 3] The checking lighting system according to claim 1 or 2 with which said 1st lens and 2nd lens consist of a Fresnel lens.

[Claim 4] The checking lighting system according to claim 1 or 2 said whose inspection object is a catalyst for automobiles.

[Claim 5]

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] Especially this invention is suitable when conducting hole plugging inspection of the catalyst equipped with the through tube for automobiles, and it relates to the checking lighting system which can be used also in inspection of the inside of the cylinder member equipped with condition inspection and the through tube of the hole of the substrate equipped with the through tube etc.

[0002]

[Description of the Prior Art] If the equipment for inspecting whether the hole of a large number currently formed in the catalyst for automobiles is choked up as the above-mentioned checking lighting system is mentioned as an example and explained Establish a lighting means to irradiate light from [ of the hole of that ] formation at a catalyst, and the tele cent rucksack lens for narrowing down so that the light in which the exposure light from the lighting means passed the hole can be incorporated for an image pick-up means is prepared. the light incorporated for the image pick-up means -- a monitor etc. -- projecting -- a hole -- he is trying to judge whether there is any plugging part

[0003]

[Problem(s) to be Solved by the Invention] Although there is an advantage which a focus does not shift and can perform a highly precise image processing when measuring the inspection object of a cube configuration with which thickness differs by using said tele cent rucksack lens, since the tele cent rucksack lens was expensive, there was un-arranging [ to which the whole equipment becomes high / cost ]. And when picturizing a big inspection object, in order to have to use the tele cent rucksack lens suitable for the magnitude, it was what makes it remarkable said to un-arrange further. Moreover, generally, since it was heavy-gage compared with other lenses, the tele cent rucksack lens had also generated un-arranging [ which a lighting system enlarges in the direction of radiation of light ].

[0004] The place which this invention tends to solve in view of the above-mentioned situation is in the point of offering the checking lighting system which can attain a miniaturization, though it is made advantageous in a cost side.

[0005]

[Means for Solving the Problem] The checking lighting system of this invention is equipped with the 2nd lens for making the light after the parallel light from the 1st lens which is made to condense the light from a lighting means to have a predetermined illuminating angle, and said lighting means, and is changed into parallel light for the above-mentioned technical-problem solution, and said 1st lens passes the through tube of formation to an inspection object condense, and making incorporation possible at an image pick-up means. The light irradiated with the predetermined illuminating angle from the lighting means is changed into parallel light with the 1st lens, and is irradiated by the inspection object. And this light can be incorporated for an image pick-up means by making the light which passed the through tube of an inspection object condense with the 2nd lens. By carrying out the image processing of the light incorporated by the image pick-up means, and projecting on a monitor etc., it can judge whether

plugging etc. has occurred in the through tube. Compared with the thing using the thing (for example, field-like illuminant which emits light in the shape of a field (it is also called a back light)) of a configuration of irradiating parallel light as said lighting means, the miniaturization of the lighting means itself can be attained not to mention the ability to aim at reduction of cost by considering as a lighting means to irradiate with an illuminating angle as mentioned above. Moreover, since an inspection object with a motion from which the location of an inspection object changes is not picturized, there is no semantics which uses a tele cent rucksack lens like before, and even if it manages the usual lens, it does not become a problem at all.

[0006] By changing a lighting means to have a predetermined illuminating angle, the 1st total reflection mirror for changing the optical axis of the light from said lighting means in the direction which intersects perpendicularly mostly, and the optical axis of the reflected light from this 1st total reflection mirror in the direction which intersects perpendicularly mostly The 2nd reflective mirror for changing this reflected light into an opposite direction with the direction of radiation from said lighting means, The 1st lens which is made to condense the reflected light from said 2nd total reflection mirror, and is changed into parallel light, The 2nd lens which makes the light after the parallel light from said 1st lens passes the through tube of formation to an inspection object condense, By changing the 3rd total reflection mirror for changing the optical axis of the light from said 2nd lens in the direction which intersects perpendicularly mostly, and the optical axis of the reflected light from this 3rd total reflection mirror in the direction which intersects perpendicularly mostly The 4th total reflection mirror for turning this reflected light in the same direction as the direction of radiation from said lighting means, and making incorporation possible at an image pick-up means may be made to have, and a checking lighting system may be constituted. The light from a lighting means is changed into an opposite direction with the direction of radiation through the 1st total reflection mirror and the 2nd total reflection mirror. By using two total reflection mirrors as mentioned above, whenever [ illuminating-angle / of the light irradiated from the lighting means ] is expanded to two steps. The reflected light from said 2nd total reflection mirror is changed into parallel light with the 1st lens, and is irradiated by the inspection object. And after being condensed with the 2nd lens and the light which passed the through tube of an inspection object is changed in the same direction as the direction of radiation from a lighting means through the 3rd total reflection mirror and the 4th total reflection mirror, it can be incorporated for an image pick-up means. By using two total reflection mirrors as mentioned above, two steps are made to condense and the light condensed from the 2nd lens can be certainly incorporated for said image pick-up image means. Moreover, compared with the case where it has arranged on a straight line, the miniaturization of the lighting system in the direction of radiation can be attained to the direction of radiation by shifting and arranging a lighting means and an image pick-up means from the direction of radiation of an inspection object as mentioned above.

[0007] The miniaturization of a lighting system can be further attained by constituting said 1st lens and 2nd lens from a Fresnel lens. Moreover, since it is easy to process said Fresnel lens, it can be easily made a square, or a perforating process can be performed.

[0008] When said inspection object is what has the small hole of a large number like the catalyst for automobiles, such a checking lighting system is advantageous.

[0009] By arranging this lighting means and this image pick-up means to a same side so that the optical axis of said lighting means and the image pick-up core of said image pick-up means may become the same location mostly, a miniaturization can be attained also in the direction which intersects perpendicularly with the direction of radiation of light.

[0010] It not only can make a special installation base unnecessary, but by constituting said 2nd lens on the installation base of an inspection object, where an inspection object is brought as much as possible close to an image pick-up means, it can picturize.

[0011]

[Embodiment of the Invention] The checking lighting system of this invention is shown in drawing 1 . 1st Fresnel lens 2 as the 1st lens which this checking lighting system makes condense the light from a lighting means 1 to have the predetermined illuminating angle S, and said lighting means 1, and is

changed into parallel light, 2nd Fresnel lens 5 as the 2nd lens for making the light after the parallel light from said 1st Fresnel lens 2 passes through tube 3A (refer to drawing 4 ) of formation for the catalyst 3 of the automobile as an inspection object condense, and making incorporation possible at the image pick-up means 4, such as a CCD camera It arranges along with the direction of radiation of the exposure light from a lighting means. It is used mainly for the catalyst 3 for automobiles (it has become with the ceramic etc.) in order to inspect plugging of the hole of formation etc., and also said checking lighting system can be used in condition inspection of the inside of the cylinder member equipped with condition inspection and the through tube of the hole of the substrate equipped with the through tube etc. Carry out the image processing of the image obtained with said image pick-up means 4, and it projects on a monitor etc., and also you may make it judge whether the image pick-up means 4 was omitted depending on the case, the light from 2nd Fresnel lens 5 was viewed directly, and the hole of a catalyst 3 is choked up. Although drawing 1 shows the condition of having floated in the air where no configuration members are being fixed, all configuration members will be contained in casing in fact. Moreover, although the location which approached the 2nd Fresnel lens 5 side of the location of said two Fresnel lenses 2 and the catalyst 3 arranged among five, i.e., the location which can be brought close to the image pick-up means 4 side, is good, it may be brought near by the 1st Fresnel lens 2 side. [0012] As shown in drawing 1 , after the light irradiated from the lighting means 1 is changed into parallel light by 1st Fresnel lens 2, it is irradiated by the catalyst 3. And it is condensed with 2nd Fresnel lens 5, and the light which passed hole 3A of a catalyst 3 is incorporated by the image pick-up means 4. The illuminating angle S of said lighting means 1 is not limited to what is shown in drawing, and can be changed according to the magnitude of an inspection object etc. Moreover, the lighting means 1 constituted by the adjustable type which can carry out adjustable [ of said illuminating angle S ] may be used.

[0013] It may be a rectangle, and although an appearance's being circular or the thing which cut the zona-orbicularis-like slot and was produced can be used for said each Fresnel lens 2 or 5, it may be the thing of what kind of configuration. Moreover, you may be other lenses, although a Fresnel lens attains the miniaturization of a checking lighting system upwards and is advantageous.

[0014] Said checking lighting system may be constituted as shown in drawing 2 and drawing 3 . That is, the 1st total reflection mirror 7 for changing optical-axis 6A of the light from a lighting means 6 to have the predetermined illuminating angle S, and said lighting means 6 in the direction which intersects perpendicularly mostly, By changing optical-axis 6B of the reflected light from this 1st total reflection mirror 7 in the direction which intersects perpendicularly mostly The 2nd reflective mirror 8 for changing this reflected light into an opposite direction with the direction of radiation from said lighting means 1, 1st Fresnel lens 9 as the 1st lens which is made to condense the reflected light from said 2nd total reflection mirror 8, and is changed into parallel light, The 2nd lens which makes the light after the parallel light from said 1st Fresnel lens 9 passes through tube 3A of formation for the catalyst 3 for automobiles which is an inspection object condense, and 2nd Fresnel lens 10 as an installation base of a catalyst 3, By changing optical-axis 6D of the reflected light from the 3rd total reflection mirror 11 for changing optical-axis 6C of the light from said 2nd Fresnel lens 10 in the direction which intersects perpendicularly mostly, and this 3rd total reflection mirror 11 in the direction which intersects perpendicularly mostly The image pick-up means 12 which turns this reflected light in the same direction as the direction of radiation from said lighting means 6, and consists of a CCD camera etc. is made to be equipped with the 4th total reflection mirror 13 for making incorporation possible, and the checking lighting system is constituted. By setting it as whenever [ same setting-angle ] to the light reflected while it is the same and constituting two total reflection mirrors 7 and 8 by the side of said irradiation appearance, and two total reflection mirrors 11 and 13 by the side of said optical incidence Although the lighting means 6 and the image pick-up means 12 can be arranged to a same side and a miniaturization in the horizontal direction of a checking lighting system can be attained, it can also carry out without arranging to a same side. Moreover, although a miniaturization in the horizontal direction of a checking lighting system can be further attained by making in agreement the image pick-up core of optical-axis 6A of said lighting means 6 and optical-axis 6E12 to said image pick-up means 12, i.e., an

image pick-up means, it can also carry out without making it in agreement. L shown in drawing 3 is transparence members, such as a transparent glass plate, a transparent plate made of synthetic resin, or a transparent silicone sheet, and it is desirable to arrange and carry out said transparence member so that it can avoid to get damaged according to the catalyst 3 with which the front face of said 2nd Fresnel lens 10 is laid in this.

[0015] Therefore, the light from the lighting means 6 is changed into parallel light with 1st Fresnel lens 9, after whenever [ illuminating-angle ] is able to extend by two total reflection mirrors 7 and 8. And said parallel light is irradiated by hole 3A of the catalyst 3 laid in 2nd Fresnel lens 10, it is condensed with 2nd Fresnel lens 10, and is further condensed by two total reflection mirrors 11 and 13, and the light which passed through the outside of the light which passed hole 3A, and a catalyst 3 is incorporated by the image pick-up means 12. Here, although the miniaturization of the lighting means 6 is attained upwards and it is advantageous by extending the light from the lighting means 6 to two steps by two total reflection mirrors 7 and 8, one total reflection mirror may be prepared and may be carried out. Moreover, the light condensed with 2nd Fresnel lens 10 is made to condense by total reflection mirrors 11 and 13, and also you may make it condense using a condenser lens etc.

[0016]

[Effect of the Invention] The 1st lens which according to invention of claim 1 is made to condense the light from a lighting means to have a predetermined illuminating angle, and said lighting means, and is changed into parallel light, Only by making the 2nd lens for making the light after the parallel light from said 1st lens passes the through tube of formation to an inspection object condense, and making incorporation possible at an image pick-up means have The inspection object equipped with the through tube can be inspected, and the miniaturization of the lighting means itself can be attained by considering as a lighting means to irradiate with an illuminating angle not to mention the ability to aim at reduction of cost compared with the thing using the lighting means of a configuration of irradiating parallel light. Moreover, a tele cent rucksack lens like before becomes unnecessary, and reduction of cost can be aimed at further.

[0017] The 1st total reflection mirror for changing the optical axis of the light from a lighting means to have a predetermined illuminating angle, and a lighting means in the direction which intersects perpendicularly mostly according to invention of claim 2, By changing the optical axis of the reflected light from this 1st total reflection mirror in the direction which intersects perpendicularly mostly The 2nd reflective mirror for changing the reflected light into an opposite direction with the direction of radiation from a lighting means, The 1st lens which is made to condense the reflected light from the 2nd total reflection mirror, and is changed into parallel light, The 2nd lens which makes the light after the parallel light from the 1st lens passes the through tube of formation to an inspection object condense, By changing the 3rd total reflection mirror for changing the optical axis of the light from the 2nd lens in the direction which intersects perpendicularly mostly, and the optical axis of the reflected light from this 3rd total reflection mirror in the direction which intersects perpendicularly mostly By making the 4th total reflection mirror for turning the reflected light in the same direction as the direction of radiation from said lighting means, and making incorporation possible at an image pick-up means have, and constituting a checking lighting system Compared with the case where it has arranged on a straight line, the miniaturization of the lighting system in the direction of radiation can also be attained to the direction of radiation by it not only can attaining the miniaturization of a lighting means, but shifting and arranging a lighting means and an image pick-up means from the direction of radiation of an inspection object.

[0018] According to invention of claim 3, the miniaturization of a lighting system can be further attained by constituting the 1st lens and the 2nd lens from a Fresnel lens. Moreover, since it is easy to process said Fresnel lens, it can be easily used as a square, or it can perform a perforating process, and becomes advantageous in a manufacture side.

[0019] According to invention of claim 5, also in the direction which intersects perpendicularly with the direction of radiation of light by arranging a lighting means and an image pick-up means to a same side, the miniaturization of a checking lighting system can be attained so that the optical axis of a lighting

means and the image pick-up core of an image pick-up means may become the same location mostly, and in an installation tooth-space side, it becomes advantageous.

[0020] According to invention of claim 6, by constituting the 2nd lens on the installation base of an inspection object, it can picturize, where an inspection object is brought as much as possible close to an image pick-up means, and it not only can make a special installation base unnecessary, but in a cost side and an inspection measuring plane, it becomes advantageous.

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[0001]

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[0002]

[Description of the Prior Art] If the equipment for inspecting whether the hole of a large number currently formed in the catalyst for automobiles is choked up as the above-mentioned checking lighting system is mentioned as an example and explained Establish a lighting means to irradiate light from [ of the hole of that ] formation at a catalyst, and the tele cent rucksack lens for narrowing down so that the light in which the exposure light from the lighting means passed the hole can be incorporated for an image pick-up means is prepared. the light incorporated for the image pick-up means -- a monitor etc. -- projecting -- a hole -- he is trying to judge whether there is any plugging part

[0003]

[Problem(s) to be Solved by the Invention] Although there is an advantage which a focus does not shift and can perform a highly precise image processing when measuring the inspection object of a cube configuration with which thickness differs by using said tele cent rucksack lens, since the tele cent rucksack lens was expensive, there was un-arranging [ to which the whole equipment becomes high / cost ]. And when picturizing a big inspection object, in order to have to use the tele cent rucksack lens suitable for the magnitude, it was what makes it remarkable said to un-arrange further. Moreover, generally, since it was heavy-gage compared with other lenses, the tele cent rucksack lens had also generated un-arranging [ which a lighting system enlarges in the direction of radiation of light ].

[0004] The place which this invention tends to solve in view of the above-mentioned situation is in the point of offering the checking lighting system which can attain a miniaturization, though it is made advantageous in a cost side.

[0005]

[Means for Solving the Problem] The checking lighting system of this invention is equipped with the 2nd lens for making the light after the parallel light from the 1st lens which is made to condense the light from a lighting means to have a predetermined illuminating angle, and said lighting means, and is changed into parallel light for the above-mentioned technical-problem solution, and said 1st lens passes the through tube of formation to an inspection object condense, and making incorporation possible at an image pick-up means. The light irradiated with the predetermined illuminating angle from the lighting means is changed into parallel light with the 1st lens, and is irradiated by the inspection object. And this light can be incorporated for an image pick-up means by making the light which passed the through tube of an inspection object condense with the 2nd lens. By carrying out the image processing of the light incorporated by the image pick-up means, and projecting on a monitor etc., it can judge whether

plugging etc. has occurred in the through tube. Compared with the thing using the thing (for example, field-like illuminant which emits light in the shape of a field (it is also called a back light)) of a configuration of irradiating parallel light as said lighting means, the miniaturization of the lighting means itself can be attained not to mention the ability to aim at reduction of cost by considering as a lighting means to irradiate with an illuminating angle as mentioned above. Moreover, since an inspection object with a motion from which the location of an inspection object changes is not picturized, there is no semantics which uses a tele cent rucksack lens like before, and even if it manages the usual lens, it does not become a problem at all.

[0006] By changing a lighting means to have a predetermined illuminating angle, the 1st total reflection mirror for changing the optical axis of the light from said lighting means in the direction which intersects perpendicularly mostly, and the optical axis of the reflected light from this 1st total reflection mirror in the direction which intersects perpendicularly mostly The 2nd reflective mirror for changing this reflected light into an opposite direction with the direction of radiation from said lighting means, The 1st lens which is made to condense the reflected light from said 2nd total reflection mirror, and is changed into parallel light, The 2nd lens which makes the light after the parallel light from said 1st lens passes the through tube of formation to an inspection object condense, By changing the 3rd total reflection mirror for changing the optical axis of the light from said 2nd lens in the direction which intersects perpendicularly mostly, and the optical axis of the reflected light from this 3rd total reflection mirror in the direction which intersects perpendicularly mostly The 4th total reflection mirror for turning this reflected light in the same direction as the direction of radiation from said lighting means, and making incorporation possible at an image pick-up means may be made to have, and a checking lighting system may be constituted. The light from a lighting means is changed into an opposite direction with the direction of radiation through the 1st total reflection mirror and the 2nd total reflection mirror. By using two total reflection mirrors as mentioned above, whenever [ illuminating-angle / of the light irradiated from the lighting means ] is expanded to two steps. The reflected light from said 2nd total reflection mirror is changed into parallel light with the 1st lens, and is irradiated by the inspection object. And after being condensed with the 2nd lens and the light which passed the through tube of an inspection object is changed in the same direction as the direction of radiation from a lighting means through the 3rd total reflection mirror and the 4th total reflection mirror, it can be incorporated for an image pick-up means. By using two total reflection mirrors as mentioned above, two steps are made to condense and the light condensed from the 2nd lens can be certainly incorporated for said image pick-up image means. Moreover, compared with the case where it has arranged on a straight line, the miniaturization of the lighting system in the direction of radiation can be attained to the direction of radiation by shifting and arranging a lighting means and an image pick-up means from the direction of radiation of an inspection object as mentioned above.

[0007] The miniaturization of a lighting system can be further attained by constituting said 1st lens and 2nd lens from a Fresnel lens. Moreover, since it is easy to process said Fresnel lens, it can be easily made a square, or a perforating process can be performed.

[0008] When said inspection object is what has the small hole of a large number like the catalyst for automobiles, such a checking lighting system is advantageous.

[0009] By arranging this lighting means and this image pick-up means to a same side so that the optical axis of said lighting means and the image pick-up core of said image pick-up means may become the same location mostly, a miniaturization can be attained also in the direction which intersects perpendicularly with the direction of radiation of light.

[0010] It not only can make a special installation base unnecessary, but by constituting said 2nd lens on the installation base of an inspection object, where an inspection object is brought as much as possible close to an image pick-up means, it can picturize.

[0011]

[Embodiment of the Invention] The checking lighting system of this invention is shown in drawing 1 . 1st Fresnel lens 2 as the 1st lens which this checking lighting system makes condense the light from a lighting means 1 to have the predetermined illuminating angle S, and said lighting means 1, and is



changed into parallel light, 2nd Fresnel lens 5 as the 2nd lens for making the light after the parallel light from said 1st Fresnel lens 2 passes through tube 3A (refer to drawing 4 ) of formation for the catalyst 3 of the automobile as an inspection object condense, and making incorporation possible at the image pick-up means 4, such as a CCD camera It arranges along with the direction of radiation of the exposure light from a lighting means. It is used mainly for the catalyst 3 for automobiles (it has become with the ceramic etc.) in order to inspect plugging of the hole of formation etc., and also said checking lighting system can be used in condition inspection of the inside of the cylinder member equipped with condition inspection and the through tube of the hole of the substrate equipped with the through tube etc. Carry out the image processing of the image obtained with said image pick-up means 4, and it projects on a monitor etc., and also you may make it judge whether the image pick-up means 4 was omitted depending on the case, the light from 2nd Fresnel lens 5 was viewed directly, and the hole of a catalyst 3 is choked up. Although drawing 1 shows the condition of having floated in the air where no configuration members are being fixed, all configuration members will be contained in casing in fact. Moreover, although the location which approached the 2nd Fresnel lens 5 side of the location of said two Fresnel lenses 2 and the catalyst 3 arranged among five, i.e., the location which can be brought close to the image pick-up means 4 side, is good, it may be brought near by the 1st Fresnel lens 2 side. [0012] As shown in drawing 1 , after the light irradiated from the lighting means 1 is changed into parallel light by 1st Fresnel lens 2, it is irradiated by the catalyst 3. And it is condensed with 2nd Fresnel lens 5, and the light which passed hole 3A of a catalyst 3 is incorporated by the image pick-up means 4. The illuminating angle S of said lighting means 1 is not limited to what is shown in drawing, and can be changed according to the magnitude of an inspection object etc. Moreover, the lighting means 1 constituted by the adjustable type which can carry out adjustable [ of said illuminating angle S ] may be used.

[0013] It may be a rectangle, and although an appearance's being circular or the thing which cut the zona-orbicularis-like slot and was produced can be used for said each Fresnel lens 2 or 5, it may be the thing of what kind of configuration. Moreover, you may be other lenses, although a Fresnel lens attains the miniaturization of a checking lighting system upwards and is advantageous.

[0014] Said checking lighting system may be constituted as shown in drawing 2 and drawing 3 . That is, the 1st total reflection mirror 7 for changing optical-axis 6A of the light from a lighting means 6 to have the predetermined illuminating angle S, and said lighting means 6 in the direction which intersects perpendicularly mostly, By changing optical-axis 6B of the reflected light from this 1st total reflection mirror 7 in the direction which intersects perpendicularly mostly The 2nd reflective mirror 8 for changing this reflected light into an opposite direction with the direction of radiation from said lighting means 1, 1st Fresnel lens 9 as the 1st lens which is made to condense the reflected light from said 2nd total reflection mirror 8, and is changed into parallel light, The 2nd lens which makes the light after the parallel light from said 1st Fresnel lens 9 passes through tube 3A of formation for the catalyst 3 for automobiles which is an inspection object condense, and 2nd Fresnel lens 10 as an installation base of a catalyst 3, By changing optical-axis 6D of the reflected light from the 3rd total reflection mirror 11 for changing optical-axis 6C of the light from said 2nd Fresnel lens 10 in the direction which intersects perpendicularly mostly, and this 3rd total reflection mirror 11 in the direction which intersects perpendicularly mostly The image pick-up means 12 which turns this reflected light in the same direction as the direction of radiation from said lighting means 6, and consists of a CCD camera etc. is made to be equipped with the 4th total reflection mirror 13 for making incorporation possible, and the checking lighting system is constituted. By setting it as whenever [ same setting-angle ] to the light reflected while it is the same and constituting two total reflection mirrors 7 and 8 by the side of said irradiation appearance, and two total reflection mirrors 11 and 13 by the side of said optical incidence Although the lighting means 6 and the image pick-up means 12 can be arranged to a same side and a miniaturization in the horizontal direction of a checking lighting system can be attained, it can also carry out without arranging to a same side. Moreover, although a miniaturization in the horizontal direction of a checking lighting system can be further attained by making in agreement the image pick-up core of optical-axis 6A of said lighting means 6 and optical-axis 6E12 to said image pick-up means 12, i.e., an

image pick-up means, it can also carry out without making it in agreement. L shown in drawing 3 is transparence members, such as a transparent glass plate, a transparent plate made of synthetic resin, or a transparent silicone sheet, and it is desirable to arrange and carry out said transparence member so that it can avoid to get damaged according to the catalyst 3 with which the front face of said 2nd Fresnel lens 10 is laid in this.

[0015] Therefore, the light from the lighting means 6 is changed into parallel light with 1st Fresnel lens 9, after whenever [ illuminating-angle ] is able to extend by two total reflection mirrors 7 and 8. And said parallel light is irradiated by hole 3A of the catalyst 3 laid in 2nd Fresnel lens 10, it is condensed with 2nd Fresnel lens 10, and is further condensed by two total reflection mirrors 11 and 13, and the light which passed through the outside of the light which passed hole 3A, and a catalyst 3 is incorporated by the image pick-up means 12. Here, although the miniaturization of the lighting means 6 is attained upwards and it is advantageous by extending the light from the lighting means 6 to two steps by two total reflection mirrors 7 and 8, one total reflection mirror may be prepared and may be carried out. Moreover, the light condensed with 2nd Fresnel lens 10 is made to condense by total reflection mirrors 11 and 13, and also you may make it condense using a condenser lens etc.

[0016]

[Effect of the Invention] The 1st lens which according to invention of claim 1 is made to condense the light from a lighting means to have a predetermined illuminating angle, and said lighting means, and is changed into parallel light, Only by making the 2nd lens for making the light after the parallel light from said 1st lens passes the through tube of formation to an inspection object condense, and making incorporation possible at an image pick-up means have The inspection object equipped with the through tube can be inspected, and the miniaturization of the lighting means itself can be attained by considering as a lighting means to irradiate with an illuminating angle not to mention the ability to aim at reduction of cost compared with the thing using the lighting means of a configuration of irradiating parallel light. Moreover, a tele cent rucksack lens like before becomes unnecessary, and reduction of cost can be aimed at further.

[0017] The 1st total reflection mirror for changing the optical axis of the light from a lighting means to have a predetermined illuminating angle, and a lighting means in the direction which intersects perpendicularly mostly according to invention of claim 2, By changing the optical axis of the reflected light from this 1st total reflection mirror in the direction which intersects perpendicularly mostly The 2nd reflective mirror for changing the reflected light into an opposite direction with the direction of radiation from a lighting means, The 1st lens which is made to condense the reflected light from the 2nd total reflection mirror, and is changed into parallel light, The 2nd lens which makes the light after the parallel light from the 1st lens passes the through tube of formation to an inspection object condense, By changing the 3rd total reflection mirror for changing the optical axis of the light from the 2nd lens in the direction which intersects perpendicularly mostly, and the optical axis of the reflected light from this 3rd total reflection mirror in the direction which intersects perpendicularly mostly By making the 4th total reflection mirror for turning the reflected light in the same direction as the direction of radiation from said lighting means, and making incorporation possible at an image pick-up means have, and constituting a checking lighting system Compared with the case where it has arranged on a straight line, the miniaturization of the lighting system in the direction of radiation can also be attained to the direction of radiation by it not only can attaining the miniaturization of a lighting means, but shifting and arranging a lighting means and an image pick-up means from the direction of radiation of an inspection object.

[0018] According to invention of claim 3, the miniaturization of a lighting system can be further attained by constituting the 1st lens and the 2nd lens from a Fresnel lens. Moreover, since it is easy to process said Fresnel lens, it can be easily used as a square, or it can perform a perforating process, and becomes advantageous in a manufacture side.

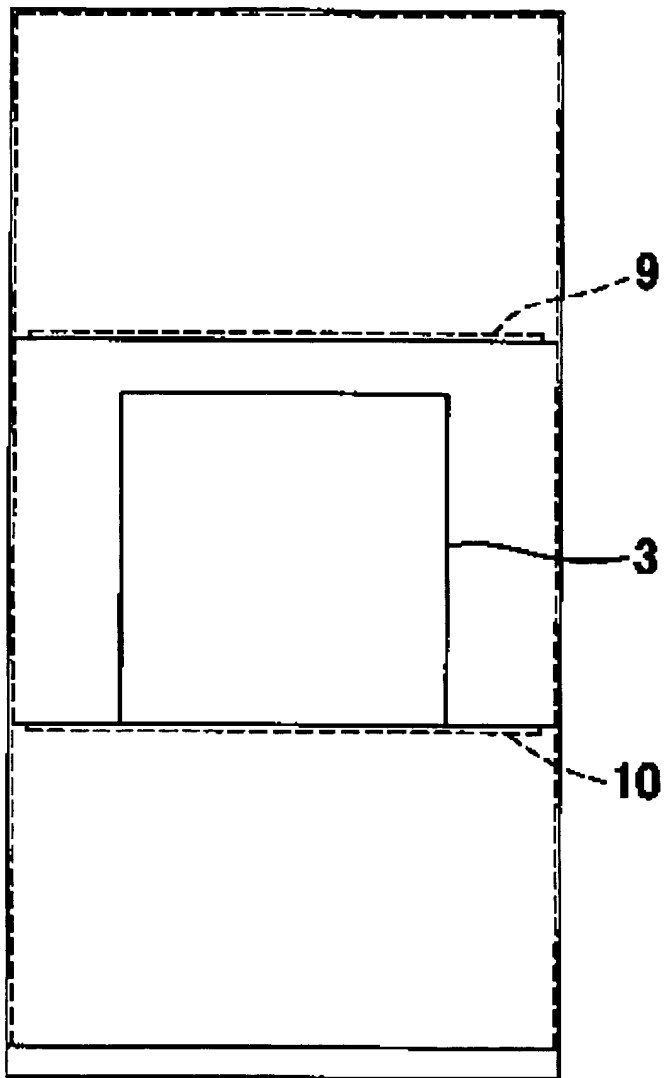
[0019] According to invention of claim 5, also in the direction which intersects perpendicularly with the direction of radiation of light by arranging a lighting means and an image pick-up means to a same side, the miniaturization of a checking lighting system can be attained so that the optical axis of a lighting

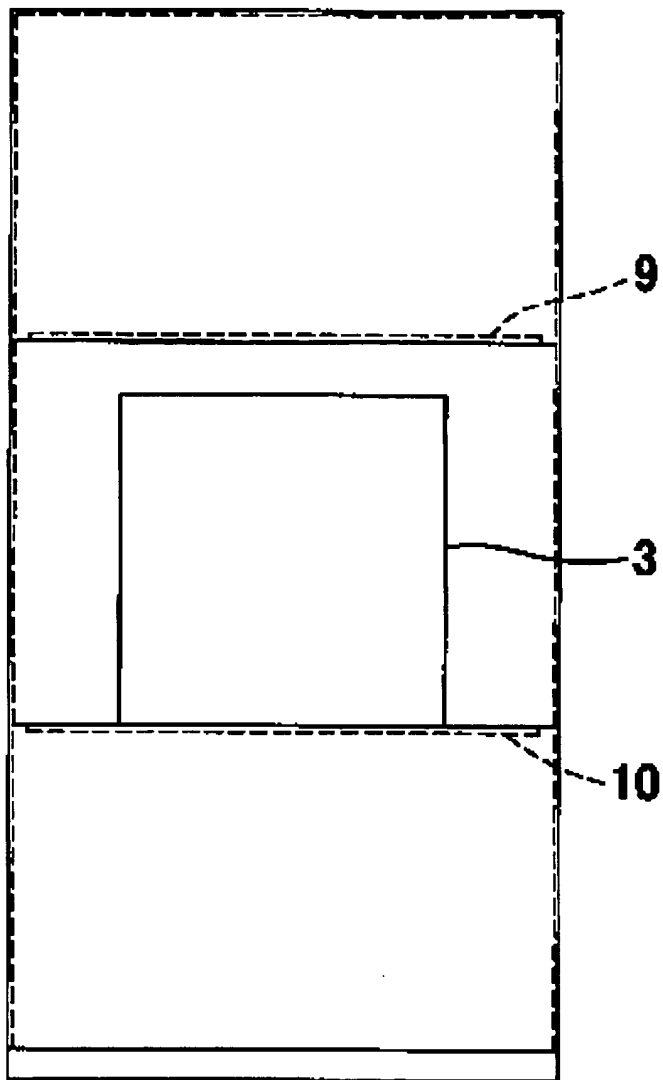
means and the image pick-up core of an image pick-up means may become the same location mostly, and in an installation tooth-space side, it becomes advantageous.

[0020] According to invention of claim 6, by constituting the 2nd lens on the installation base of an inspection object, it can picturize, where an inspection object is brought as much as possible close to an image pick-up means, and it not only can make a special installation base unnecessary, but in a cost side and an inspection measuring plane, it becomes advantageous.

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[Translation done.]





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